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THE FUNGUS TRIBE.

CHAPTER IV.

DR. BADHAM, the author from whom we have so frequently quoted, says:—"For the single mushroom that we eat, how many hundreds there be that retaliate and prey upon us in return. To enumerate but a few, and those of the microscopic kinds: the *Mucor mucedo*, that spawns upon our dried preserves; the *Ascophyton mucedo*, that makes our bread mouldy; the *Uredo segetum*, that burns Ceres out of her own corn-fields; the *Uredo rubigo*, whose rust is still more destructive; and the *Puccinia graminis*, whose voracity sets corn-laws and farmers at defiance, are all funguses." The main body of those fungi which make war on man are microscopic; yet so strong and indefeasible are they in their multitudes and their pertinacity, that man has in most instances no power to withstand their forces. Their very minuteness is in their favour, for who can stand against an invisible, noiseless, and scentless foe, whose very presence he has no means of detecting until he has fairly taken possession of his property at every assailable point? To the list given above, we must add many more. There is the Ergot (*Spermaedia clavus*), a species which infests grasses and corn. When developed in the latter, it produces the most dreadful disease in those who unfortunately partake of the infected grain. It is chiefly found in rye, but happily not very frequently met with in this country. Berkley says: "It is most curious that this production, when occurring in great abundance among rye, as it does frequently when that grain is extensively cultivated, and unavoidably composing a considerable part of the bread, gives rise to one of the most fearful and distressing diseases with which the human race is afflicted; in which the limbs gradually waste away with horrible pain, and eventually fall off." This little fungus, though so dangerous in its effects when eaten, is nevertheless invaluable for its medicinal uses. It is a little cylindrical horn-shaped body; purple-black without, and white or purplish inside.

Whether the injury to human life of which we have spoken is caused by the fungus itself, or by the decomposed and corrupted state of the corn to which it belongs, is still a matter of question amongst the learned, and one on which we can, of course, form no judgment.

The genera which chiefly affect the cereal produce of our land are the *Uredines* and *Pucciniae*. The former genus takes its name from *uro*, a Latin word, signifying "to burn," or "scorch," the discolourations and spots on the plants infested by these fungi having been formerly attributed to blasts or injuries caused by the atmosphere or the heavenly bodies. There are two species of this genus that are almost equally dreaded by the farmer; one called "the smut" (*Uredo segetum*), the other, "the bunt" (*Uredo caries*).

The former of these takes its rise within the glume of living plants, and grows with such rapidity as speedily to fill the interior space and burst through the epidermis; when it appears like a profuse black dust, which, if microscopically examined, is found to consist of minute, perfectly spherical sporules. Withering says of this species: "It consists of very minute, egg-shaped, stemless capsules, at first white, but the thin white soon bursting, it pours out a quantity of brown-black powder mixed with wool-like fibres."

The other species, *U. caries* (fig. 1), is very common in wheat, and exceedingly injurious, as it not only destroys the ear on which it grows, but every grain with which the infected individuals come in contact. It is included within the germ of the wheat, and the spores, which are exactly spherical, are longer than those of the above-named species (*U. segetum*), and quite black. When crushed they emit a most fetid odour, which is communicated to the whole sample of wheat with which the bunt grains are associated. Mr. Berkley says of all the corn-infesting fungi: "The growth of these parasites depends so much on accidental circumstances, that it is impossible for the most experienced cultivators to guard against it entirely; but the evil is greatly lessened by careful choice of seed, and by steeping it in solutions of different

substances, which destroy the vegetative power of the spordia of these parasites, etc."

The other genus, *Puccinia*, is of as evil a nature as the *Uredines*. The disease termed "the mildew" in wheat is produced by one of these (*Puccinia graminis*, fig. 2), a fungus so diminutive that a single *stoma* (or pore in a stem or leaf), itself a thing invisible to an ordinary eye, will produce from twenty to forty of these fungi; and each of these exquisitely minute plants will bring forth at least a hundred spores or seeds. The seeds are not much heavier than air; and it may easily be conceived that even a single stem of wheat or grass, when beset with these mischievous parasites, will not be long in infecting all the corn, not only in the field where the injured wheat grows, but in all those adjacent to it.

The first appearance of this blight is usually in the spring, or early in the summer, when it arises in the form of orange-coloured streaks, which afterwards assume a deep chocolate-brown. The tufts of this fungus are dense and often confluent, and forming long parallel lines (fig. 2, *d*). The spores are contained in a tubercular double-celled case, and are black; this case is supported by a filiform peduncle or stem, as seen in fig. 2, *b*.

There is a fungus exceedingly like this, if not the same, which infects barberry-trees. It is larger; but as different soils produce different-sized specimens of the same species of fruit and other vegetables, so may different living soil nourish the same parasite into more or less luxuriance. It is certain, at all events, that wheat or other corn grown in the neighbourhood of the barberry-tree always gets blighted with this *Puccinia*, and it is, therefore, not unreasonable to think that it may be infected by it. It has been suggested (and probably with reason), that the reproductive particles or spores of this and other fungi are dispersed by the air, and sucked in with the water which falls on them into the earth, whence they are absorbed by the pores of plants, and so introduced into their system. In other cases, where they have lodged on the leaves or other external surface of the plants, they are washed by the rain into the stomata or mouths with which the cuticle of almost all plants is thickly beset, and by means of which they drink in a portion of the dew and rain from heaven; and these spring up and grow, intercepting the supplies of moisture from the plant, and at the same time interfering with its functions of respiration, by blocking up the pores; and thus they weaken and destroy the plants on which they feed, so that the grains on a stalk of wheat infected by this disease are not half the size, nor have they the same proportionate amount of farina that those grown on healthy stems possess. It is, however, a remarkable fact, adduced by the best authorities, that these poor diminutive grains will, if sown, produce as fine a crop as the finest and most flourishing seeds. This is worthy of remark, as, though useless or nearly so for food, the withered grains may thus be turned to account, and save the farmer's better samples for other uses.

But it is not on our corn-fields only that a plague of fungi rests; these little *pucciniae* attack the leaves of plum and other fruit-trees, devour the fluids of our bean-plants, and scatter themselves in destructive armies over our raspberry-bushes and our rose-beds (figs. 3 and 4). There are some forty or more species which spread themselves in all directions on the leaves and stems of our plants and flowers, nor ever cease their ravages until they have destroyed the vitality of whatever part they touch.

But we must now turn to another class of fungi—those which beset our dainties under the name of "mould." There is so interesting an account of this production in a paper published in the pages of a contemporary, that we cannot do better than transcribe a part of it as it stands. "If, during the warm weather, we put aside a bit of bread, or a slice of apple, pear, melon, or a turnip or potato-peeling, if nothing better is at hand, we shall find in a few days that all those substances will have assumed a mouldy appearance.

Take a little of this mould gently off on the point of a pen-knife, and subject it to the microscope: you see in the moulded bread a grove of tall stalks, each with a round head slightly flattened; in short, a mushroom in miniature. This is the *Mucor mucedo* (fig. 6, a), the fungus of the bread-mould. While fresh and young, they are of a beautiful milk-white colour; gradually they assume a yellowish tinge. The stalks are so transparent as, under a good magnifying power, to show the cellular structure inside; the bulb also now exhibits, under a thin bark or skin, a number of minute circular bodies, all arranged in a compact form: these are the spores or seeds. After a day or two more, the fungi begin to ripen, and assume a brownish tint; the bulbs blacken; the skin bursts, and innumerable spores are scattered about, many floating away in the air. This forest of mould, like larger ones, is liable to accidents. You may see in one corner, for instance, that the bit of bread forming the soil has cracked; thus a fungus has been loosened at the root, and it falls down, we may suppose, with a crash, though we still desiderate instruments to magnify and make audible the sound. Nevertheless, the effects of the fall are visible in the breaking down of neighbouring stems, and in the premature scattering of the seed. You may see, too, sometimes the scattered seeds collect upon one or two plants, and, enveloping them, entirely destroy their vitality, and thus cause old, rotten-looking stumps."

It would indeed be curious and interesting if any instruments could be discovered which would extend the scope of the other senses in a degree commensurate with what has been done for that of sight. If we could hear the sounds emitted by microscopic insects, and smell the odours exhaled from invisible and, as we now believe, scentless microscopic vegetables, it is not unlikely that many new and remarkable phenomena would be made known to us. But such discoveries remain as yet unthought of.

But it must not be understood that the mouldiness which we find on our eatables is always a crop of the same species of fungus, or even of different species of the same genus. It is not so. The kinds which infest the apple and the pear are different, and those which "rot and then fatten on" our grapes, plums, and raspberries, are all different from each other. Then there are other kinds which float in our fermented liquors; whilst others again are found within the nutshell; and even within the innermost cavities of the walnut. Some, "like leeches, stick to the bulbs of plants, and suck them dry;" whilst others, not content with a vegetable diet, lay hold of the hoofs of horses and the horns of cattle; nay, worse and worse may be said; for instances have been known of the lungs and other organs of human beings having been beset by these all-destructive little beings. It is also recorded that it is a rare thing to find a mouth, whether of man or woman, where the teeth are not more or less the habitats of these vegetables, which, it is said, can be kept off only by the free use of a well-soaped tooth-brush.

Fungi not only prey on objects which are members of other families than their own, but they unscrupulously devour each other. Many of the *Pileati* have parasitic fungi, which attach themselves solely to them, never attacking any other species. One sort settles itself on dried *Agaries*; another only on moist decaying ones; whilst a third devours only the flesh of a particular *Boletus*. Dr. Badham says: "Few minute objects are more beautiful than these mucidinous *fungi fungorum*. A common one besets the back of some of the *Russulae* in decay, spreading over it, especially if the weather be moist, like thin flocks of light wool, presenting on the second day a bluish tint on the surface. Under a powerful magnifier myriads of little glass-like stalks are brought into view, which bifurcate again and again; each ultimate head ending in a semilucent head, or button, at first blue, and afterwards black; which, when it comes to burst, scatters the spores, which are then (under the microscope) seen adhering to the sides of the delicate filamentary stalks, like so many minute limpets. There is a very beautiful fungus called "the pencilled mould" (*Aspergilla penicillatus*, fig. 5), which clusters its pretty beaded tassels on the dried plants in our herbariums. This little

plant consists of a stem and a cluster of sporules at the top; not unlike a brush with a handle. *Aspergillus* is the name of the brush with which the holy water is sprinkled in Roman Catholic churches, and from this resemblance the genus takes its name. *Nemaspora Carpini* (fig. 6, d) is another curious species. This infests the dead wood of the Hornbeam, its singular black spores escaping from their flat cases, and thrusting themselves upwards in the form of tendrils. Then there are the many species of *Sphaeria*, which raise their little button-like forms on the branches of trees, and stud them over with sphere-like gems, some yellow, others scarlet, brown, black, orange, white, crimson, and a hundred other tints of richest dye. Sometimes these wonderfully varied little fungi are sessile on the substance they have selected for their habitat, as at fig. 7, c, d, and e; at others they are raised on stalks. Some have smooth visible orifices through which the spores escape; in others, these openings are hairy; and in some species they are not visible at all.

Besides frequenting living plants, and closely besetting their leaves and branches, fungi of this genus are found abundantly on the bark of dead branches, and even on the wood where the bark has been removed. They frequent also the flock of *Agaries*; and one species, "the nest-like *Sphaeria*," is found in the little hollows of bean-roots, whilst others cluster on apples that are lying on the ground, the stems of reeds, or even on the naked earth. There are some species which take up their abode and obtain their sustenance from dead larvæ, pupæ, and spiders' eggs; whilst one, cannibal-like, "the red Parasitic *Sphaeria*," sucks the blood of some of the species of its own genus. So numerous are the species which rank under this genus, that 201 are catalogued by Berkley.

Racodium cellare, "the mouse-skin byssus," is the fungus which festoons and covers the walls of our wine-cellars. For specimens, Badham refers us to the "London Docks, *passim*, where he pays his unwelcome visits, and is in even worse odour than the excisemen." Loudon tells us that it takes its name from a word "used among the Greeks" for a worthless, worn-out, ragged garment, which has been applied to the present genus in allusion to the dirty, interwoven, cloth-like substance with which it clothes whatever it grows on. *R. cellare* is the black substance which overruns the bottles of the wine-merchant, and which often hangs in long thick festoons from the sides and roof of his wine-cellars.

There is a very curious species of fungus which is found overspreading the thing on which it grows like froth. Withering, on the authority of Stackhouse, thus describes it:—"Its first appearance is like custard spilt upon the grass or leaves. This soon becomes frothy, and then contracts around the blades of grass or leaves in the form of little tubercles united together. On examining it in its different stages under the microscope, it first appeared like a cluster of bubbles, irregularly shaped, and melting into one another. In the second stage it appeared imbricated, or tiled, with open cells, the edges of the cells beautifully waved. A blackish powdery matter, on the surface of the cells, now gives the plant a grayish cast. In the third stage, the wavy imbrication disappears, and the plant settles with minute tubercles united together. Some of these are closed; but many of them appear as if torn open, and out of the cavity emerge little downy strings, with irregular-shaped terminations, and other similar irregular bodies on the same strings, like the heads of some of the genus *Mucor*."

The blight which has lately beset the vines and trees whence we have been used to obtain our supplies of raisins and currants (which, if it continues to exert its evil influence, will reduce poor John Bull to the necessity of finding a substitute for the delight of the nation, plum-pudding), is said to be produced by a growth of fungi; but whether this is so is, as yet, scarcely an ascertained fact.

From all we have said, our readers will not be slow in admitting that, minute as these little plants are, and apparently insignificant, they are capable of being made, in the hands of God, instruments of most serious and destructive effects, not only to the property, but also to the life of man.

We must not, however, forget, that although some of the fungus tribe are undoubtedly most injurious in their ravages when they beset our crops or attack our timber, yet it cannot be questioned that the whole tribe has a very important part to play in the economy of nature, and is exceedingly useful to us in many ways. We have seen that some of them are

out seems to have a special commission to assist in the work of scavengers, by aiding the multitudinous host of grubs, reptiles, and other devourers, in removing decayed matter (both animal and vegetable), which, if left to putrefy, would in many instances become destructive both to the comfort and health of those higher beings to whom it has pleased God to

FIG. 1.



UREDO CARIES (THE BUNT).



a A piece of wheat, natural size, infected with the *Puccinia graminis*.
b The separate fungi magnified.

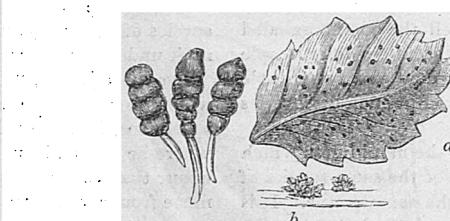
c Fungi magnified.

d A section of infected straw, highly magnified.

FIG. 2.



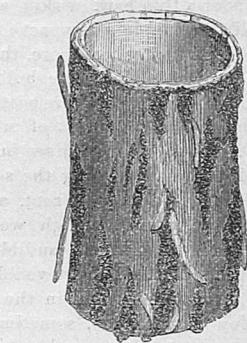
FIG. 4.



PUCCINIA RUBI.

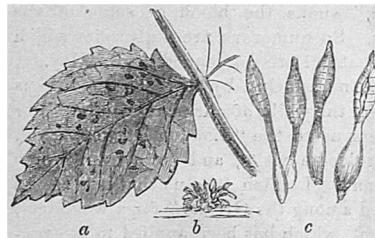
a Natural size. b Tufts magnified.
c Fungi magnified.

FIG. 5.



d A cluster of

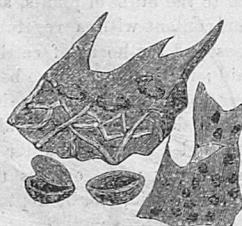
FIG. 3.



PUCCINIA ROSÆ.

a Natural size on leaf. b The same magnified.
c Separate fungi, much magnified.

FIG. 6.



ASPERGILLA FUMIGATUS.

c XYLOMA CONCAVUM.



d NEMASPORA CARPINI.

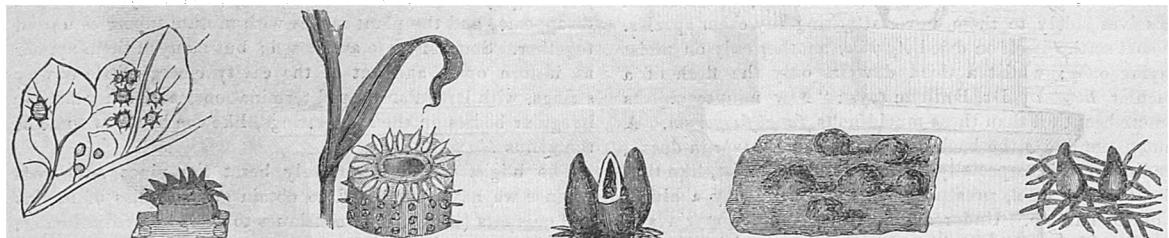
a MUCOR MUCEDO.

b MUCOR STERCOREA.

c XYLOMA CONCAVUM.

d NEMASPORA CARPINI.

FIG. 7.



a PHACIDIUM CORONATUM. b DOTHIDEA TYPHINA. c SPHÆRIA REPTANS. d SPHÆRIA TUBERCULOSA. e SPHÆRIA ROSELLA.

capable of being turned to important uses as a nutritious and wholesome article of diet, and that others have medicinal properties which render them highly valuable. One kind is employed in making ink, another is used in the place of leather, whilst several kinds are serviceable in dyeing.

Besides these and other individual uses, the tribe through-

place the whole creation in subjection; and thus the absence of this tribe of the vegetable kingdom from the earth would prove infinitely more injurious to their interests than all the ravages of those species which combine against them in the form of "smut," "bunt," "mildew," "mould," or "dry-rot," or whatever else could possibly be.